L5353
Profibus-DP
Communications
Interface

Technical Manual

HA470380   Issue 4

Safety Information

Please read this information BEFORE installing the equipment.

Intended Users

This manual is to be made available to all persons who are required to install, configure or service equipment described herein, or any other associated operation.

The information given is intended to highlight safety issues, and to enable the user to obtain maximum benefit from the equipment.

Application Area

The equipment described is intended for industrial motor speed control.

Personnel

Qualified personnel should carry out installation, operation and maintenance of the equipment. A qualified person is someone who is technically competent and familiar with all safety information and established safety practices; with the installation process, operation and maintenance of this equipment; and with all the hazards involved.
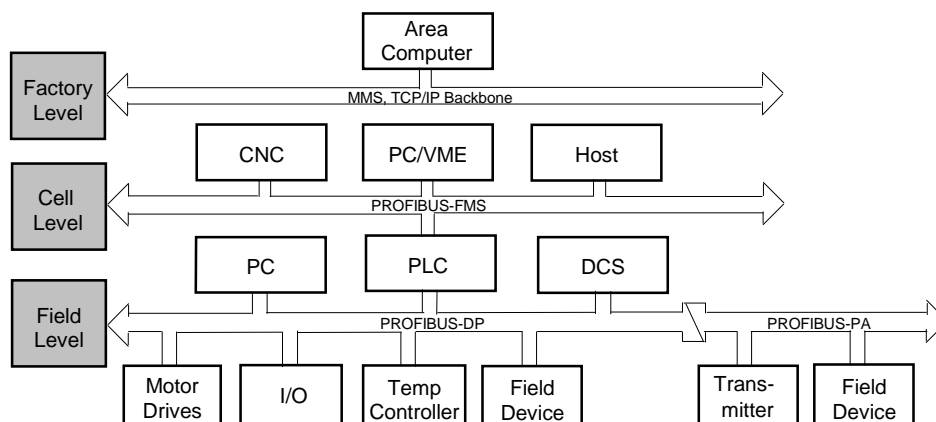
REFER TO YOUR MAIN PRODUCT MANUAL FOR SPECIFIC SAFETY INFORMATION ABOUT THE DEVICE YOU ARE CONTROLLING

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System Overview

Figure 1 PROFIBUS Application Areas

The PROFIBUS Option supports the PROFIBUS-DP variant of the PROFIBUS protocol, which is designed especially for communication between automatic control systems and distributed I/O at the device level. It is most often used to allow a central Programmable Logic Controller or PC based control system to use external 'slave' devices for I/O or specialized functions. The principal advantage is that these devices may be distributed around a machine, thereby saving on the cost of point-to-point wiring. The 'open' nature of the network also permits equipment from different manufacturers to be mixed on the same bus. Additionally, the off-loading of complex and specialized tasks such as PID temperature control lessens the processing load on the central PLC so that its other functions may be carried out more efficiently and requires less CPU memory.

The PROFIBUS Protocol

PROFIBUS is a vendor independent, open fieldbus standard for a wide range of applications in manufacturing, process and building automation. Vendor independence and openness are guaranteed by the PROFIBUS standard EN50170. With PROFIBUS, devices from different manufacturers can inter-communicate. Suitable interfaces exist for PLC's that include the Siemens, Mitsubishi and Allen Bradley range.

PROFIBUS-DP (De-central Periphery) is described in DIN 19245 Part 3, and forms part of EN 50170 with P-Net and WorldFIP. However it is important to note that P-Net and WorldFIP are **wholly incompatible** with PROFIBUS, using different wiring and transmission technologies.

The PROFIBUS-DP network uses a high-speed version of the RS485 standard, permitting baud rates of up to 12Mbaud.

A maximum of **32** PROFIBUS-DP stations (nodes) may be contained within a single network segment.

PROFIBUS-DP is a multimaster, master-slave, token passing network. More detailed information, including a detailed guide to products available, may be obtained from the various worldwide PROFIBUS user organizations. You will find contact information in trade magazines or by reference to http://www.profibus.com on the World Wide Web.

1. **PROFIBUS-PA** is designed especially for process automation. It permits sensors and actuators to be connected on one common bus line even in intrinsically safe areas. PROFIBUS PA permits data communication and power over the bus, using intrinsically safe, 2-wire technology according to the international standard IEC 1158-2, but may also be used on the standard RS485 cabling for non-intrinsically safe applications.

2. **PROFIBUS-FMS** is the general-purpose solution for communication tasks at the cell level.

Principles of Operation

Figure 2-1a: Plant wiring conventional comms. systems
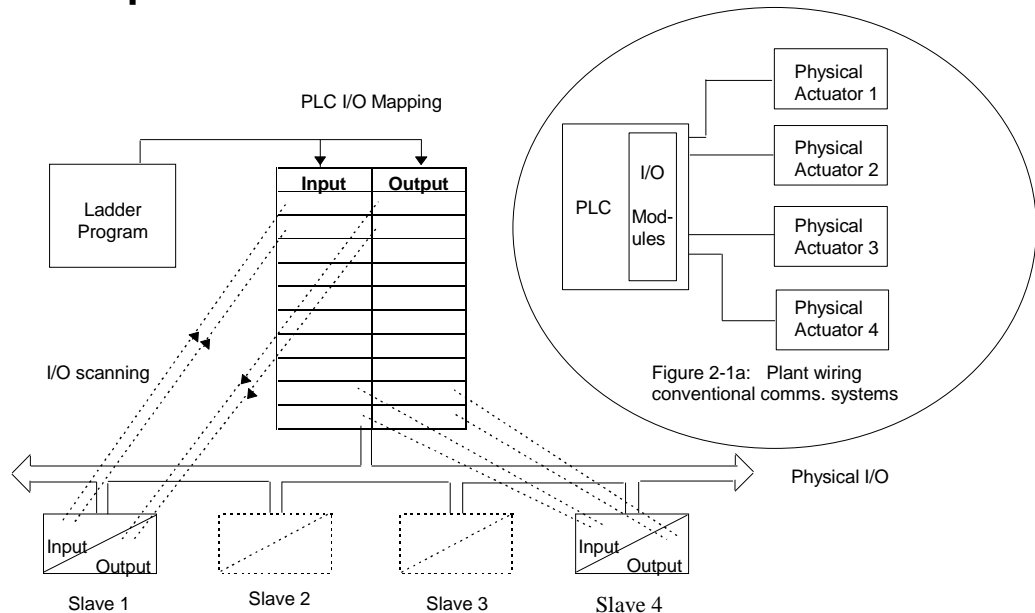
Figure 2 PROFIBUS compared with conventional communication systems

PROFIBUS-DP distinguishes between master devices and slave devices. It allows slave devices to be connected on a single bus thus eliminating considerable plant wiring typical with conventional communications systems. The Figure above compares the two systems.

Master devices determine the data communication on the bus. A master can send messages without an external request when it holds the bus access rights (the token). Masters are also called active stations in the PROFIBUS protocol.

Slave devices are peripheral devices. Typical slave devices include input/output devices, valves, motor drives and measuring transmitters. This means they will only respond to a master when requested to do so. PROFIBUS-DP is based around the idea of a 'cyclical scan' of devices on the network, during which 'input' and 'output' data for each device is exchanged.

I/O Data Exchange

The process of reading the inputs and writing to the outputs is known as an I/O data exchange. Typically, the parameters from each slave device will be mapped to an area of PLC input and output registers or a single function block so that the controlling ladder logic or program interfaces with the device as if it were an internally fitted module. It is NOT necessary, therefore, for the programmer to know anything about the physical network. The process of network configuration is usually performed using a PC based program, which allows the devices on the network to be defined and device parameters to be mapped into the PLC registers or function blocks.

The cyclical scan occurs in the following order:
1. Values from each slave device, 'Input Data', are first scanned over the network into a pre-defined set of input registers in the master controller. The values might be a set of digital input readings for a digital input unit, or the measured temperature and alarm status from a PID controller.
2. The master then runs its control program, (such as a ladder logic program) using the input data read from the slave devices.
3. The master writes output values (output data) into a pre-defined set of output registers. For example, one of the digital inputs read in the input data might be used to select one of a set of setpoints to be sent to the PID controller.
4. These outputs are then written to each slave device, and the scan-process-write cycle repeats.

Typically no more than 16 bits of input data and 16 bits of output data are exchanged for each device during the data exchange. The Profibus LinkCard implementation of the PROFIBUS-DP standard provides the possibility of transferring 112 words in each direction.

The input and output data lengths for a given device is variable and it is possible to have devices with only input data, only output data, or both.

The input and output data mixture used by a given slave device is defined by the GSD file. For simple devices such as digital or analog I/O blocks, it is fixed. However, since more complex devices often have a much wider choice of possible values to send, it is usually possible to edit the GSD file to change the mapping of device parameters into Profibus inputs or outputs. This is the case with the Profibus LinkCard, which also allows access to parameter data not in the GSD Input/Output data file.

The GSD file is imported into the PROFIBUS Master Network Configuration software before the network is created.

Note: PROFIBUS Input Data =Values sent from a slave device to a master controller or PLC.

PROFIBUS Output Data =Values sent from a master controller or PLC to a slave device.

DSD viewpoint is looking toward the master controller or PLC.

Profibus Write block is data transfer to the master controller or PLC.

Profibus Read block is data transfer from the master controller or PLC.

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Product Features

- Suitable for use with Link modules:

  L5392   LinkStation
  L5300/1   LinkRack

- Connection using shielded, twisted-pair cable
- LED's to indicate board and communications status
- Configured using Function Block inputs and outputs
- Diagnostics using Function Block outputs
- Automatic Baud Rate selection
- Software-selectable Slave Address
- 112 16 bit words in and 112 16 bit words out

Product Code

The Technology Option is supplied separately.

Part Number: L5353   Profibus LinkCard

Installation

Wiring the System

> ### WARNING!
> Before installing, ensure that the LinkRack wiring is electrically isolated and cannot be made "live" unintentionally by other personnel.
>
> Wait 5 minutes after disconnecting power before working on any part of the system or removing the covers from the drives.

The Profibus Option is provided as a plug-in LinkCard.

Note: A 2-wire system can only be used in a network in which all devices use their tri-state capability. Data flow is restricted; that is, transmit and receive cannot be simultaneous (half duplex).

Cable Specification

Either of the two cables types detailed below can be used but we recommend Type A as it allows higher speed and longer cable length.

	Type A cable	Type B cable
Characteristic Impedance:	135 to 165Ω at a frequency of 3 to 20MHz.	135 to 165Ω at a frequency of >100kHz
Cable capacitance:	< 30pF per meter	typically <60pF per meter
Core diameter:	Max. 0.34 mm², corresponds to AWG 22	maximum 0.22mm², corresponds to AWG24
Cable type:	Twisted pair cable. 1x2 or 2x2 or 1x4 lines	twisted pair cable. 1x2 or 2x2 or 1x4 lines
Resistance:	< 110Ω per km	-
Shielding:	Copper shielding braid or shielding braid and shielding foil	Copper shielding braid or shielding braid and shielding foil

Maximum Line Length per Segment

| Baud rate (kbit/sec)	9.6	19.2	93.75	187.5	500	1500	12000
Type A cable	1200m	1200m	1200m	1000m	400m	200m	100m
Type B cable	1200m	1200m	1200m	600m	200m	-	-

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Grounding the Shield

The PROFIBUS standard suggests that both ends of the transmission line should be connected to safety earth. If you do this, ensure that differences in the ground potentials do not allow circulating currents to flow. These can induce large common mode signals in the data lines and can produce potentially dangerous heating in the cable. If in doubt, ground the shield at only one section of the network.

Terminating Resistors

- If the LinkCard is at the end of the network terminating resistors are required.

- All other Profibus Devices in the system should not have terminators.

Use terminating resistors (Resistors ±5%, ¼ watt or higher) on the LinkCard.if it is at the end of the Profibus network.
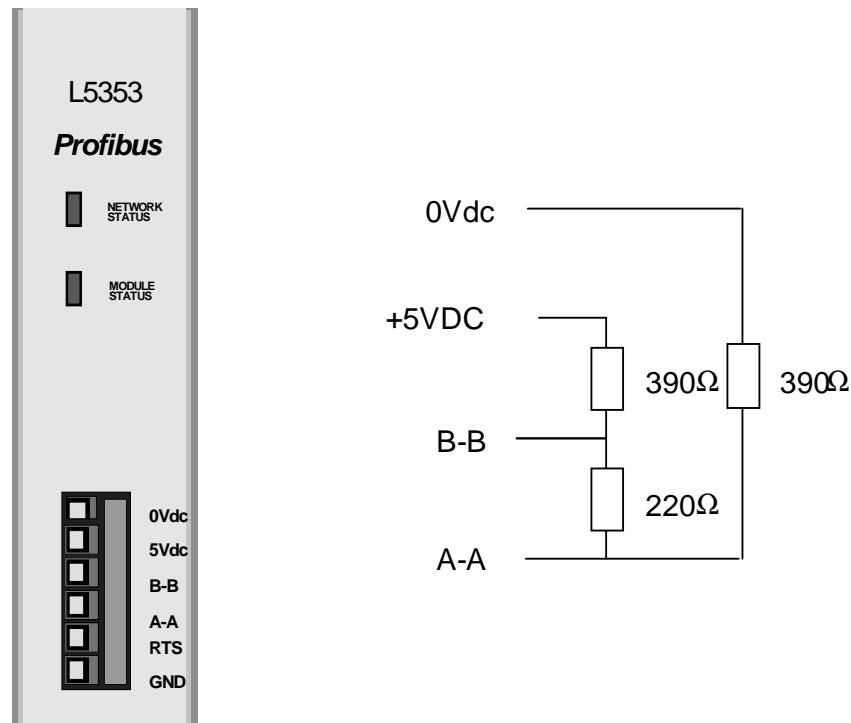
Terminal Block (TB1) Connections

TB1 Terminal	Reference	Meaning
1	0Vext	Signal reference for PROFIBUS
2	+5VDC	+5VDC/50mA supply for PROFIBUS
3	B-B'	Receive/Transmit Data Positive
4	A-A'	Receive/Transmit Data Negative
5	RTS	For connecting repeater (TTL)
6	GND	Ground connection for EMC

Fitting the Profibus LinkCard

L5353

Profibus

NETWORK STATUS

MODULE STATUS

0Vdc
5Vdc
B-B
A-A
RTS
GND
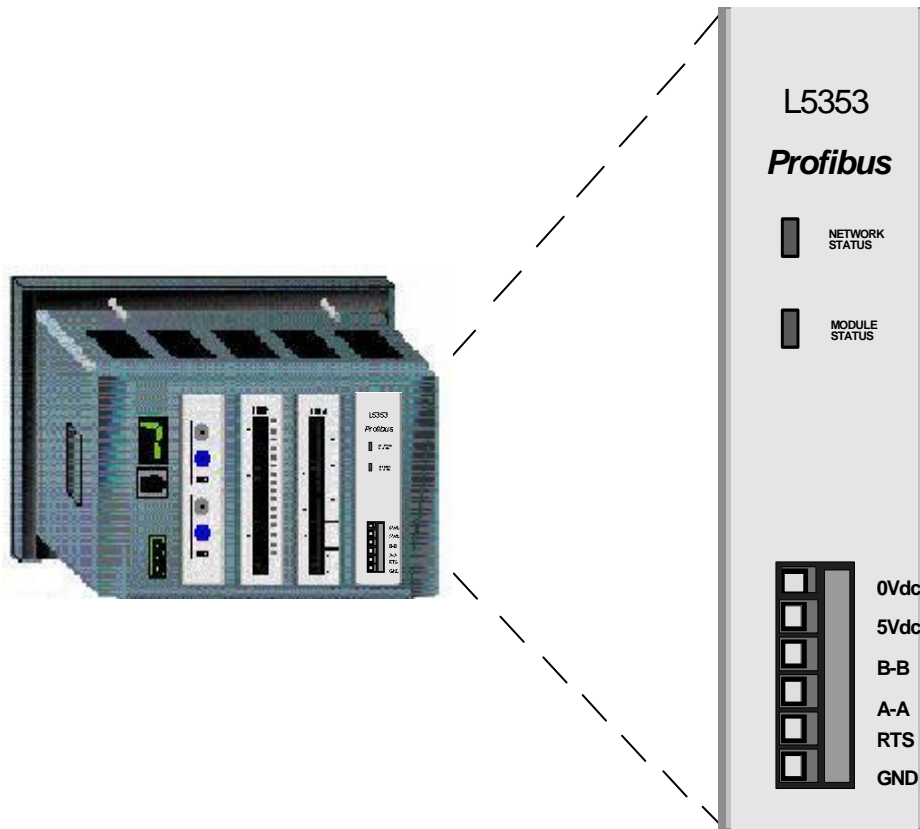
Note: The Profibus LinkCard may be installed into any site (J1, J2, J3, or J4) of the LinkRack.
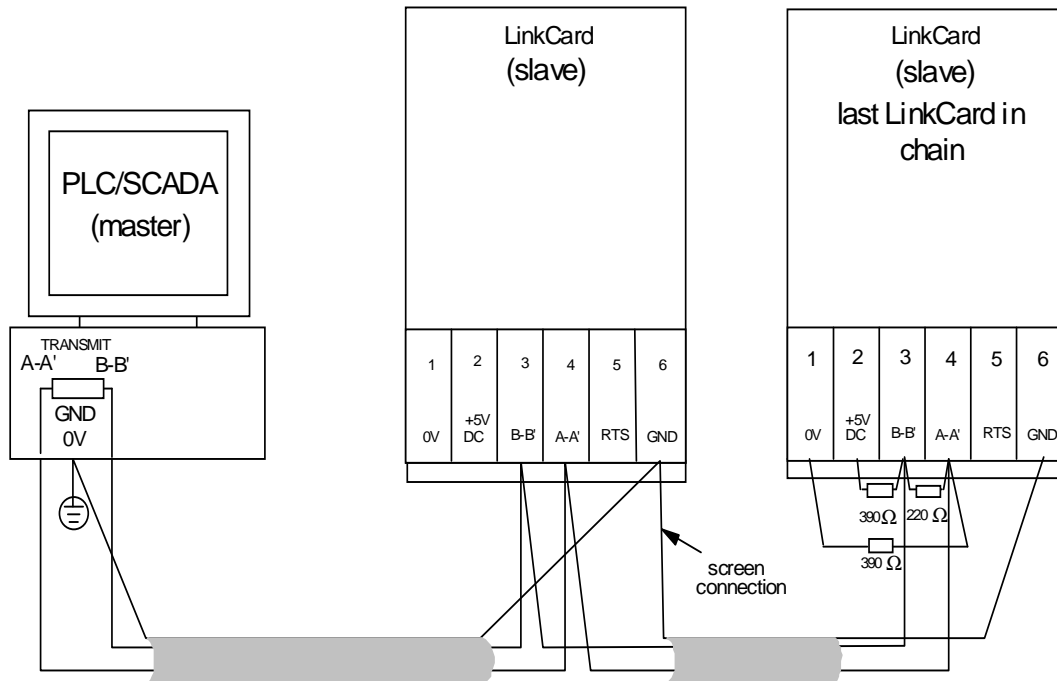

WARNING!
Ensure that all wiring is isolated.

Installing the Profibus LinkCard
The Profibus LinkCard Option plugs into a LinkRack

• Remove the back cover of the LinkRack

• Install the Profibus card into the recess on the back of the LinkRack.

• Re-fit the back cover to the LinkRack

• Make all user-wiring connections. Refer to Wiring Diagram, Figure 3**.**

Wiring Diagram

Figure 3 Typical Wiring Diagram

Note: The diagram above shows the terminal block orientation for the Profibus LinkCard. When the LinkCard is in place, the terminal order is effectively reversed - remember this when making user-connections.

Note: The screen connections for the Profibus LinkCard terminate on the ground connection of the terminal block.

Understanding the LED Indications

Initial Check for Connection

With the correct connections to the active PLC/SCADA supervisor, the MODULE LED will be ON continuously and the NETWORK LED will indicate the Idle State with a short flash.

ON	⬛	MODULE LED
SHORT FLASH	◯●	NETWORK LED

Network and Module LED Indications

		Network LED Indicates the state of the connected network.	Module LED Indicates the set-up state of the LinkRack Card. The states indicated are those produced by the FAULT parameter of the LinkCard function block.	
LED Indication		Description	FAULT Parameter	Description
OFF	◯	Disabled or Baud search	HARDWARE	Not Configured in Link Project or Hardware Fault - external
FLASH	◯●	Wait Configuration	TYPE MISMATCH	Wrong type or disabled
LONG FLASH	⬛◯	Data exchange with error	PARAMETER	Set-up fault, parameter values out-of-range
ON	⬛	Data exchange	NONE	Valid set-up, ready for external communications

Note: The NETWORK LED is always in the OFF State when the MODULE LED is not ON continuously; indicating that the LinkCard is not receiving external communications or the PLC is off.

Profibus LinkCard Set-up

Programming Considerations

The maximum amount of either input or output data that will fit in the DataExchange message is 244 bytes.

The C_PBW and C_PBR blocks each require 16 bytes (8 words). So the maximum number of each type of block is 15, which is 240 bytes.

If the total number of C_PBW and C_PBR blocks are limited the maximum to 27 or less, the blocks may be declared in the Profibus Master individually

Example: either an 8 word input or an 8 word output.
15 Inputs + 12 Outputs = 27 blocks
12 Inputs + 15 Outputs = 27 blocks
14 Inputs + 13 Outputs = 27 blocks
13 Inputs + 14 Outputs = 27 blocks

If the maximum total number of C_PBW and C_PBR blocks is increased to 28, some of the blocks must declared in the Profibus Master as 8 word input/output.

Example: input/output blocks
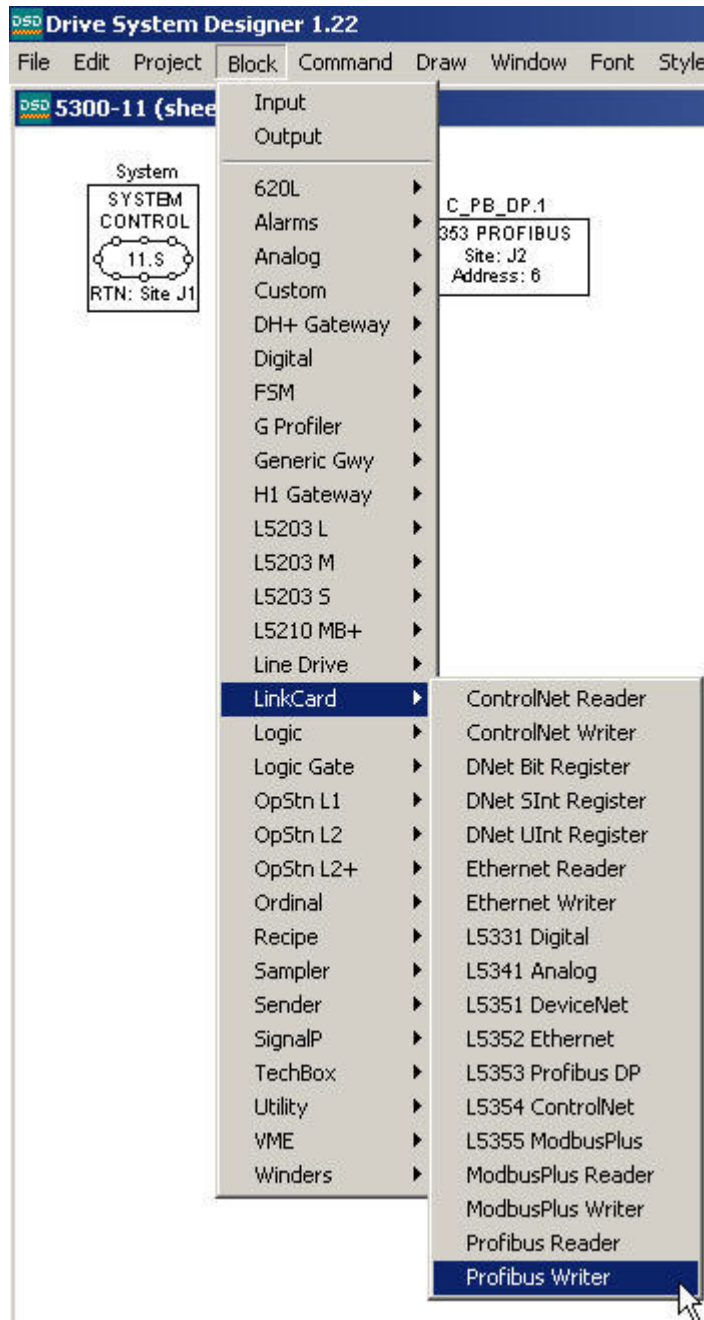13 Inputs/13 Outputs + 2 Inputs = 28 blocks
13 Inputs/13 Outputs + 2 outputs = 28 blocks
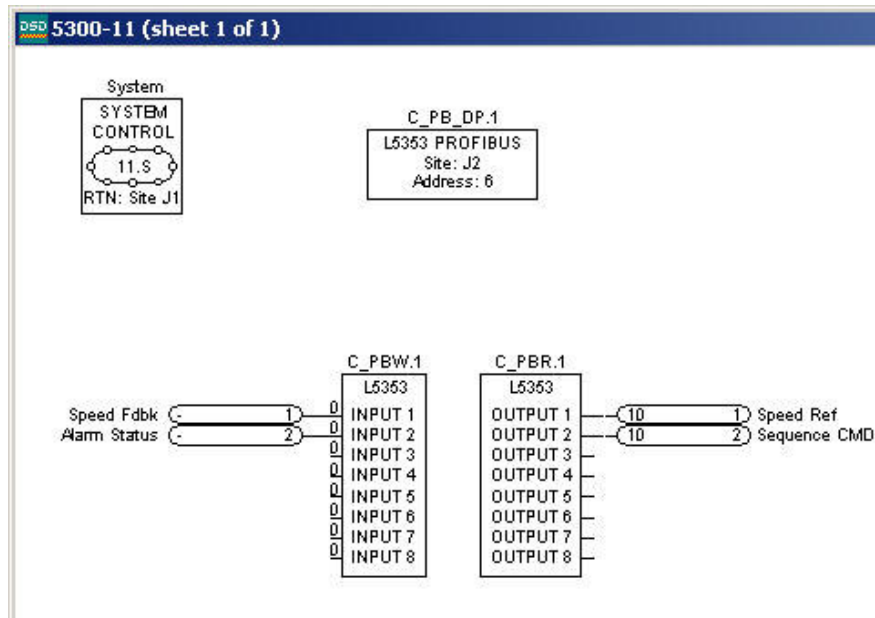13 Inputs/13 Outputs + 1 Inputs and 1 Output = 28 blocks
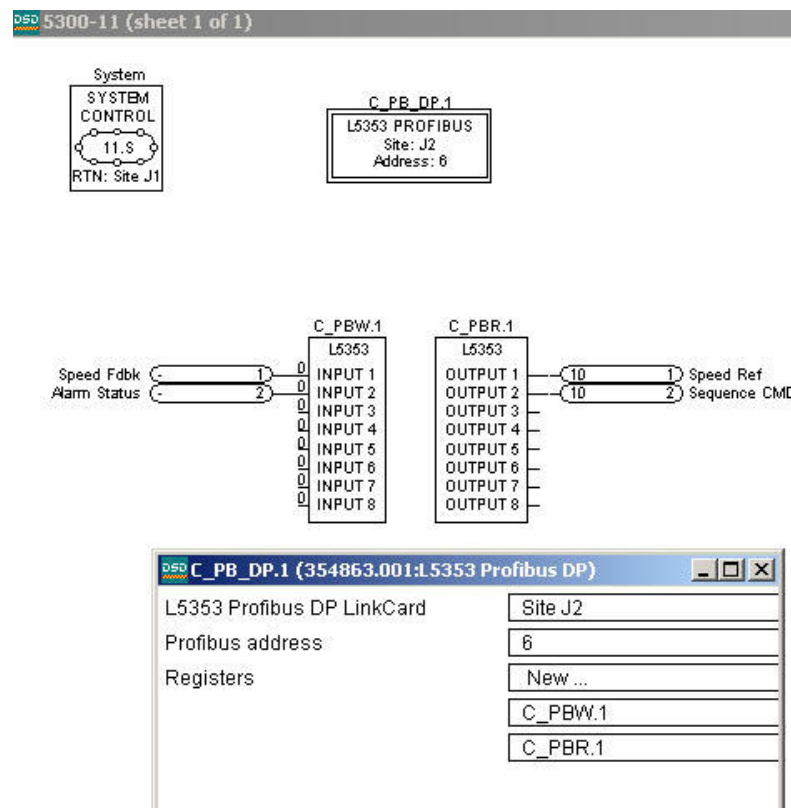Or any other combination that equals 28 blocks

LinkRack Configuration

.Select the L5353 Profibus DP LinkCard.
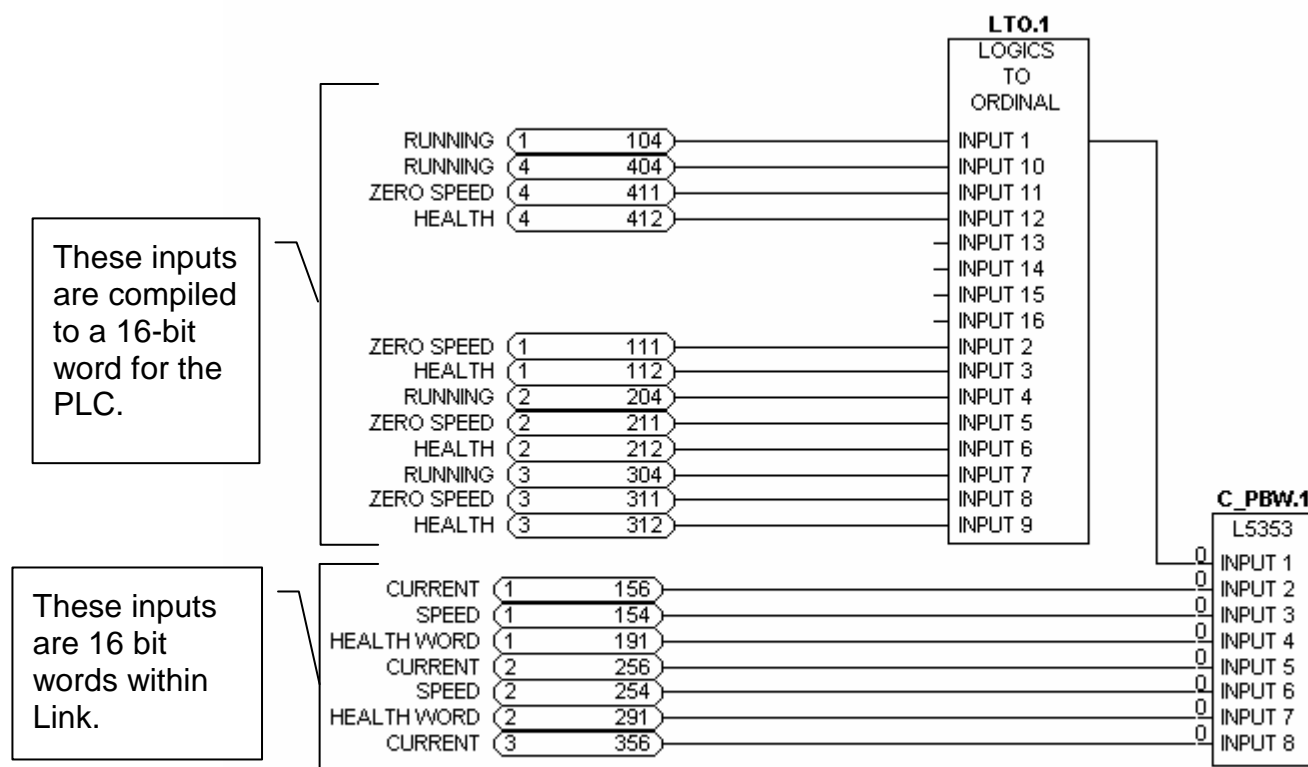
Select Profibus Reader and Writer blocks desired.

Map desired connections to the Profibus Registers

**Insert registers into the Profibus Control Block**

Logical to Integer and Value LINK Setup

```
                                                            LTO.1
                                                          LOGICS
                                                            TO
                                                          ORDINAL
                          RUNNING  (1        104)         INPUT 1
                          RUNNING  (4        404)         INPUT 10
                       ZERO SPEED  (4        411)         INPUT 11
                          HEALTH   (4        412)         INPUT 12
                                                          INPUT 13
┌──────────────────┐                                     INPUT 14
│ These inputs     │                                     INPUT 15
│ are compiled     │                                     INPUT 16
│ to a 16-bit      │   ZERO SPEED  (1        111)         INPUT 2
│ word for the     │      HEALTH   (1        112)         INPUT 3
│ PLC.             │     RUNNING   (2        204)         INPUT 4
└──────────────────┘  ZERO SPEED  (2        211)         INPUT 5
                          HEALTH   (2        212)         INPUT 6
                         RUNNING   (3        304)         INPUT 7
                      ZERO SPEED   (3        311)         INPUT 8     C_PBW.1
                          HEALTH   (3        312)         INPUT 9     L5353
                                                                   0 INPUT 1
┌──────────────────┐     CURRENT   (1        156)                  0 INPUT 2
│ These inputs     │      SPEED    (1        154)                  0 INPUT 3
│ are 16 bit       │  HEALTH WORD  (1        191)                  0 INPUT 4
│ words within     │     CURRENT   (2        256)                  0 INPUT 5
│ Link.            │      SPEED    (2        254)                  0 INPUT 6
└──────────────────┘  HEALTH WORD  (2        291)                  0 INPUT 7
                         CURRENT   (3        356)                  0 INPUT 8
```

The above configuration is an example of bit packing into an integer value.

Integer to Logical and Value LINK Setup
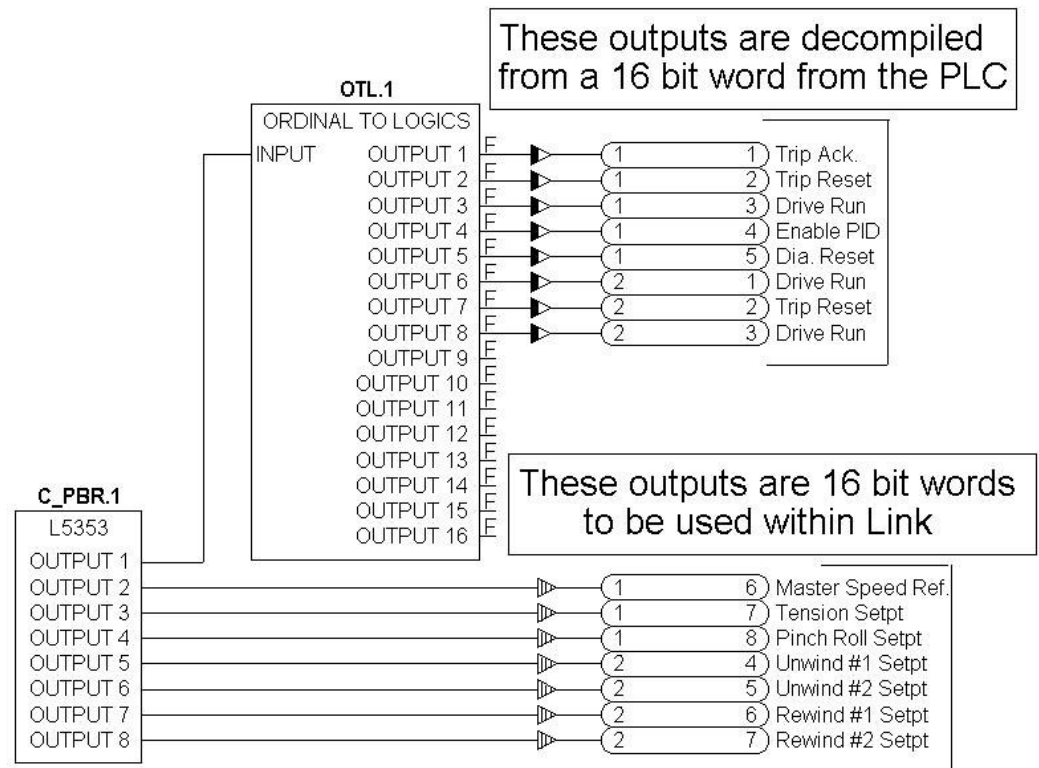
The above configuration is an example of bit picking from an integer value.

Configuring the PLC/SCADA Supervisor

Programming Considerations

The following considerations should be made while programming the PLC or Scada Supervisor

The maximum amount of either input or output data that will fit in the DataExchange message to the L5353 is 244 bytes.

The read and write blocks each require 16 bytes (8 words). So the maximum number of each type of block is 15, which is 240 bytes.

If the total number of read and write blocks is limited the maximum to 27 or less, the blocks may be declared in the Profibus Master individually

Example: either an 8 word input or an 8 word output.
15 Inputs + 12 Outputs = 27 blocks
12 Inputs + 15 Outputs = 27 blocks
14 Inputs + 13 Outputs = 27 blocks
13 Inputs + 14 Outputs = 27 blocks

If the maximum total number of C_PBW and C_PBR blocks is increased to 28, some of the blocks must declared in the Profibus Master as 8 word input/output.

Example: input/output blocks
13 Inputs/13 Outputs + 2 Inputs = 28 blocks
13 Inputs/13 Outputs + 2 outputs = 28 blocks
13 Inputs/13 Outputs + 1 Inputs and 1 Output = 28 blocks
Or any other combination that equals 28 blocks

Our example uses the <u>Siemens S7 315-2DP</u> PLC and Step 7 Simatic Manager Configuration tool. The PLC type and CPU have been selected prior to configuring the Profibus interface.
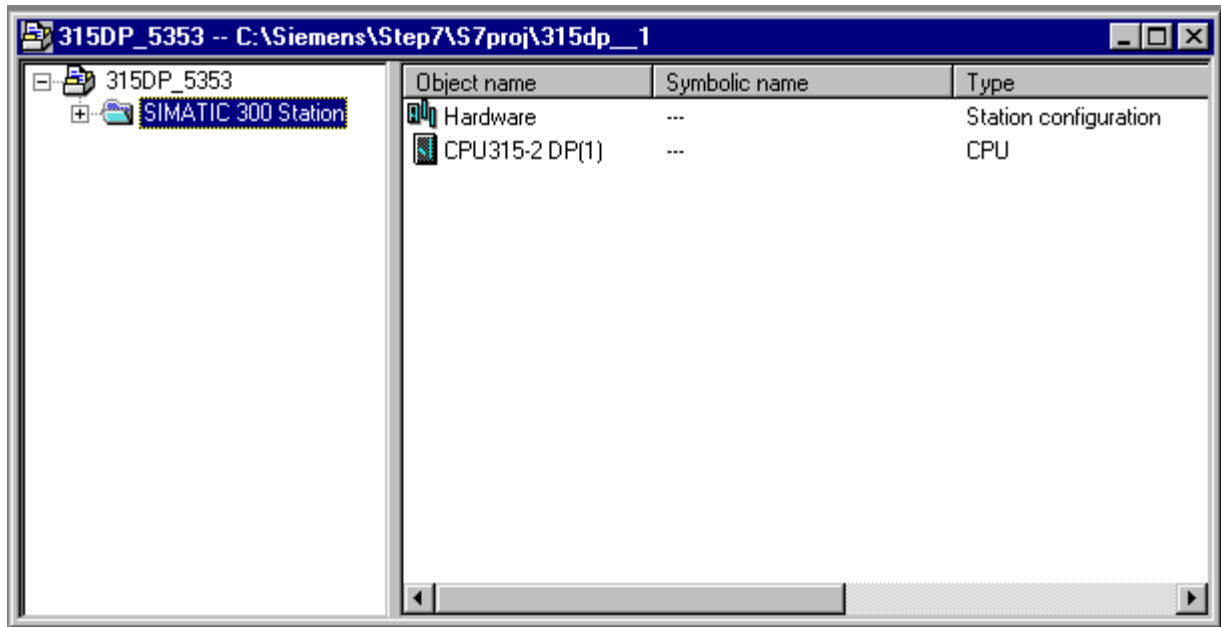
Import/Install the GSD file Euro5353.gsd or SSD5353.gsd..
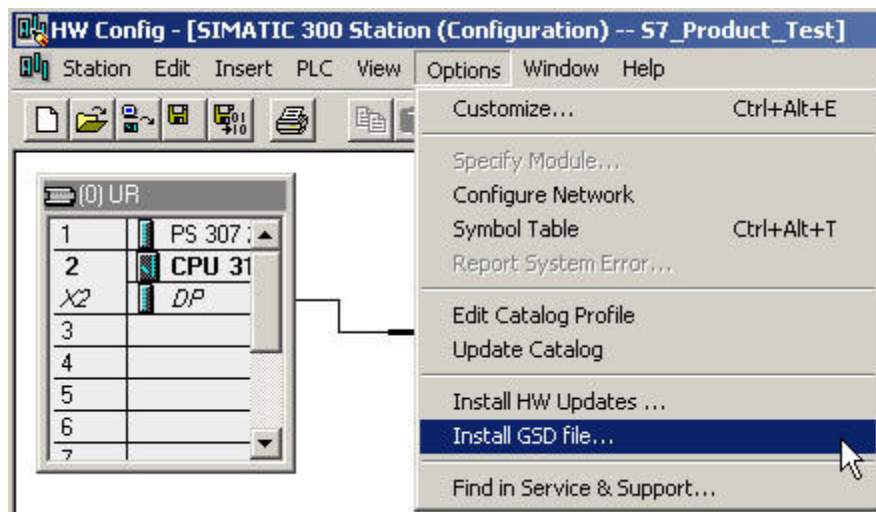
Enable the DP Mode to be Master to add modules.
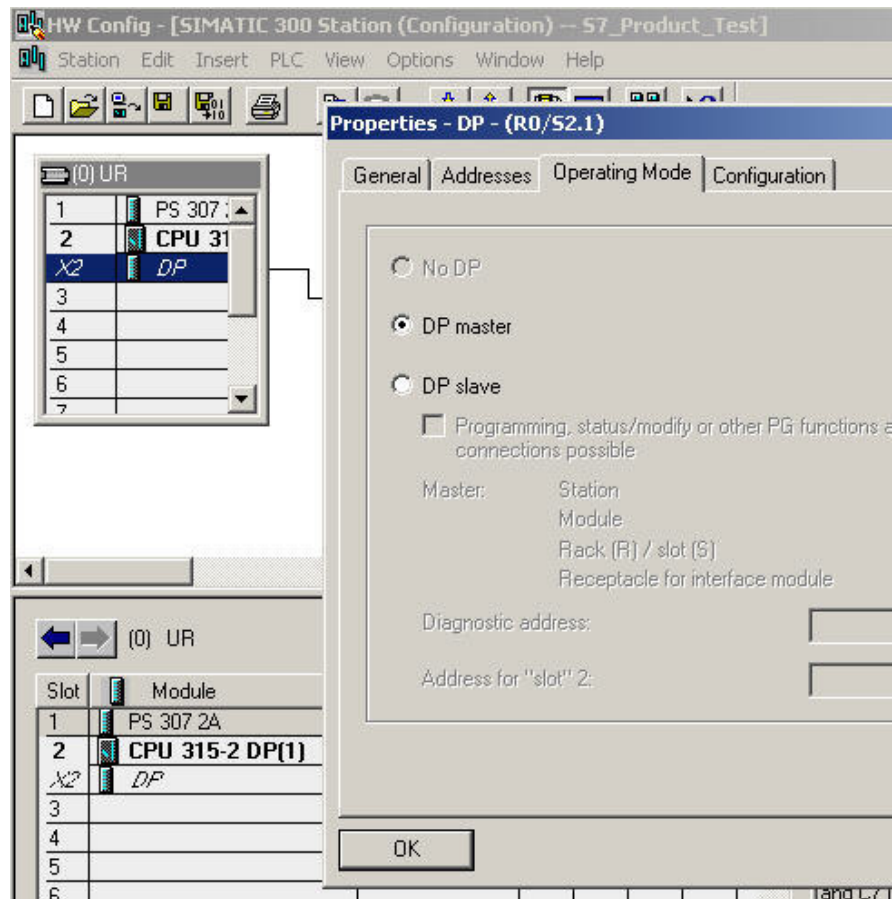
Selection of register type

1. Universal Module can be configured for the desired Input, Output or both. Must be in multiples of 8.
2. Eight words to the Master.
3. Eight words from the Master.
4. Eight words to and from the Master
5. Eight consistent words to the Master.
6. Eight consistent words from the Master.
7. Eight consistent words to and from the Master.

Note: Some Profibus programs require the Consistent word format. The Link program does not differentiate between the Consistent word and Standard word formats.

Note: The Input word on the PLC side relates to a Link Writer. The output word on the PLC side relates to a Link Reader.

Note: Figure A and Figure B below are examples of a properly configured Master and LinkCard for 8 words of data being transmitted and received each way. The order of the input/output words configured in the Profibus Master must match exactly as those configured in Link. The Network LED on the L5353 will blink red/green indicating the error.

PLC Configuring Tips

Note: The PLC must be powered prior energizing the Link Rack!!

The following Organization Blocks, OB82, OB85, OB86, and OB122, are required to complete the setup for the PLC. These Organization Blocks keep the PLC from stopping communications and simulating a fatal error to the module.

Note: The following changes are made within the Hardware Configuration.

1.) Double click on the DP master system connection.

2.) Click the Properties button in the DP master system, then Network Settings.

3.) Click the Bus Parameters button in the DP master system.

4.) Uncheck the "Turn on Cyclic Distribution of the Bus Parameters".
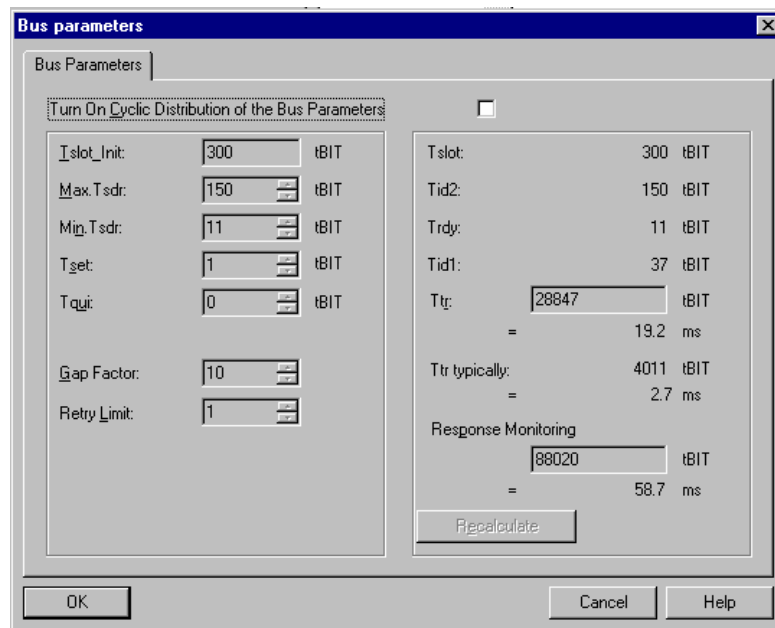
Troubleshooting

NETWORK	MODULE	Cause/Symptom	Remedy
⬭ (OFF)	⬭	No power at the drive.	Check and apply power to the drive.
⬭	⬭	Hardware fault. L5353: Verify state of the HEALTH and RUN LED's.	If HEALTH and RUN LEDS are OFF, replace the drive; else replace the Technology Box/Option.
⬭	⬭●	The self-test has failed.	check Bus Parameter setting. Replace LinkCard
⬭	⬛	No communications or intermittent failure	Check wiring, verifying the continuity of A and B connections to the master, and ensure that the correct terminals have been used. Pay particular attention to the integrity of the screening.
⬭	⬛	No communications or intermittent failure	Ensure that the last unit on the transmission line is terminated correctly. Note that some equipment has built-in resistors, which may be switched in and out of circuit.
⬛○	⬛	Read/Write failure	Mapping of Input/Output words doesn't match the Link Configuration.
⬛	⬛	The unit should now be working.	If there is still a problem, please check PLC tips

Module Status LED

This bi-color (green - red) LED provides device status. It indicates whether or not the device is powered and operating properly. Table 1 defines the different states of the Module Status LED.

Table 1

Status	*LED State*	*Reason*
Power off	**Off**	• No power applied to the device • Host LINK2 module is not running its configuration
Device in standby	**Green**	• Device needs commissioning because of missing, incomplete or incorrect configuration • PLC is off
Device operational	**Green**	• The device is operating in a normal condition
Configuration fault	**Red**	• LINK2 configuration calls for too many reader/writer blocks.
Device Self-test failure	**Flashing Red**	• Device self test failure – may need replacing, try power down/up sequence

Network Status LED

This bi-color (green - red) LED indicates the status of the communications link. Table 2 defines the different states of the Network Status LED.

Table 2

Status	*LED State*	*Reason*
Off-line	**Off**	• The device may not have power applied to it. Look at Module Status LED • The device has no Profibus Master • PLC power off
On-line	**Green**	• Profibus Master cycling through its configuration steps • Communicating with, correct configuration between L5353 and Master
Connection time-out – lost Master connection	**Flashing red**	• Master connection previously established has been lost and has not been re-established • Check mapping with relations of the input/output words related to the Link configuration
Device Self-testing	**Flashing Red / Green**	• Device in self-test mode, initializing problem, configuration error

Technical Specifications

Environmental

Operating temperature	0°C to 50°C (32 to 122^{0}F)
Storage temperature	-10 °C to +70 °C (14 to 158^{0}F)
Humidity	85% RAH. In a dry, non-condensing environment
Enclosure Rating	Touchsafe IP20. To be mounted inside a L530X, L5392 series enclosure

Supply Voltage

Supply Voltage	5VDC, supplied by backplane 5VDC supplied to network (isolated - 20mA maximum)
Current Consumption	275 mA @ 5VDC
Power Dissipation	1.375 W

Profibus	
Connection Types	Process Data parameters selected by PROFIBUS-DP Master. Demand Data protocol to provide random access to any network parameter.
Baud Rate	Auto-Baud search 9.6/19.2/93.75/187.5/500/1500Kbaud and 12Mbaud
Data Types	Unsigned Integers (*LINK* Ordinals)
Indicators supported	Network status bi-color LED, Module status bi-color LED
Transfer delay	Typically < 1 ms *LINK* input to Profibus output and vice-versa
Configurability	LinkCard configuration performed using DSD or ConfigEd. Profibus network and PLC programmed independently
Connector type	6 pin Phoenix Combicon or equivalent.

Physical

Height	120mm (4.72 in)
Width	32mm (1.25 in)
Depth	90mm (3.54in)
Weight	0.16 kg (0.35 lbs)